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AUTHOR	Frank, David
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ABSTRACT

This brief describes the findings of a consortium on indoor air quality (IAQ) in educational facilities held in Chattanooga, Tennessee. The objective was to determine the impact floorcoverings have on indoor air quality in schools relative to maintenance, volatile organic compounds (VOCs), airborne contaminants, moisture, surface contaminants, and product construction. As each type of floorcovering was discussed relative to the issues, participants began to formulate a consensus defining the proper floorcovering conducive to improved IAQ in schools. Floorcoverings reviewed were vinyl composition tile, conventional carpeting, and vinyl cushion tufted textile. The consortium also addressed preventing mold and mildew, controlling dust and particles, and eliminating VOCs. (EV)

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CEFPI
The School Building Association

ISSUETRAK

A CEFPI Brief on Educational Facility Issues

Topic : From the Ground Up: Floorcovering Recommendations From an IAQ Consortium

Issue Tracker: David Frank

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CEFPI BRIEF

FROM THE GROUND UP: FLOORCOVERING RECOMMENDATIONS FROM AN IAQ CONSORTIUM

A good planner must always have one eye on the present and another eye into the future. In the case of school planners, the future vision must in many cases extend from 30 to 50 years out in order to cover the life expectancy of a new school facility.

This is particularly true when it comes to planning for long-term good indoor air quality (IAQ). As most planners know, indoor air quality is now one of the most pressing issues facing school facilities. According to the Environmental Protection Agency, poor IAQ is a significant problem in almost half the elementary and secondary schools in the U.S., and now ranks as one of the top public health hazards.[1] The stakes are high. Additionally, students' learning and achievement capabilities can be severely hampered by poor IAQ.

These and other key issues were examined at a recent consortium on indoor air quality in educational facilities held in Chattanooga, Tennessee. Representatives from throughout the U.S. attended, including experts on air quality research and product testing, medical practice, environmental issues, and representatives from the educational communities including school administrators, facility planners, engineering, construction and maintenance practitioners.

IAQ Consortium Objective

The objective of the IAQ Consortium was to determine the impact floorcoverings on indoor air quality in schools relative to maintenance, VOC's, airborne contaminants, moisture, surface contaminants and product construction. The combined experience of the professionals involved in the consortium provided a unique platform to openly discuss these issues. As each type of floorcovering was discussed relative to the issues, participants began to formulate a consensus that would help to define the proper floorcovering conducive to improved IAQ in schools.

The Consortium agreed that the ideal floorcovering would be easy to maintain, use little or no chemicals, and have a resilient surface finish. With regard to VOCs, the floorcovering would have minimal off-gassing at the time of installation, use no wet adhesives, and require no harsh chemicals during maintenance. In addition, the floorcovering should be able to be easily repaired if damaged. Ideally, it would hold airborne contaminants out of the breathing zone, but allow them to be easily removed during scheduled maintenance. The flooring would not support microbial growth, provide a food source or allow moisture to pass through any part of the product when installed. Further, it would dry easily and would be able to be restored if flooded with water Surface contaminants could be easily removed and would remain near the surface for ease of maintenance. The floorcovering would be constructed in such a way so that each component would enhance the overall performance. Ideally, it should have a minimum life cycle of 20 years, be cost-effective, and enhance the learning environment through acoustics, non-glare, thermal comfort and color. The flooring should be easy to install and, in addition to meeting IAQ concerns, the product should provide sustainable environmental solutions.

Overview of Flooring Types Reviewed

The Consortium began discussions by reviewing the three main types of flooring specified for schools today: vinyl composition tile (VCT), conventional carpeting (broadloom), and vinyl cushion tufted textile (VCTT).

[1] U.S. Environmental Protection Agency, Indoor Air, http://www.epa.gov/iaq/index.html

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Vinyl Composition Tile (VCT)

As background, VCT hard surface flooring is the successor to VAT (vinyl asbestos tile) – a hard-surface, durable flooring that was the choice for schools for more than 50 years. However, with concerns over asbestos, VAT was replaced with VCT (vinyl composite tile). VCT is frequently specified because it generally costs a little less at installation than the other flooring choices. However, as the Consortium noted, since VCT carries a maximum warranty of five years, the short life cycle and high maintenance costs alter the cost equation.

Additionally, the Consortium members noted that there is great concern within the educational community about the ergonomic failings of VCT. VCT's hard surface is prone to glare, slips and falls, and noise escalation. In addition, the flooring causes IAQ concerns; when VCT is washed and waxed, the cleaning supplies emit volatile organic compounds known as VOCs.

While VCT may not be the best choice for conventional classrooms, libraries and corridors, VCT still works well for restrooms, cafeterias, art rooms, and other areas where easy clean-up is essential. VCT can handle frequent spills better than either conventional carpet or VCTT.

Conventional Carpeting

Conventional (also known as broadloom) carpeting enjoyed popularity in late 60s and 70s because it could offer what VCT could not: learning benefits of good ergonomic comfort, noise and light control. It also avoided some of the problems relative to IAQ, as cleaning could be accomplished without the use of harsh chemicals. However, conventional carpet has not been considered a major option for schools because it has been difficult to maintain. Originally intended for home and light commercial uses (such as executive offices), conventional carpet has been unable to withstand the punishing school environment. Although typically warranted for 10 years, many of the Consortium members noted that it tends to delaminate, zipper (develop loose threads) and crush down within the first two years.

FLOORCOVERING APPLICATION FOR SCHOOLS

	HARD SURFACE	CARPET*	VCTT
ENTRANCES	Mats only	Mats only	Mats only
CORRIDORS	◆	◆	◆◆◆
CLASSROOMS	◆	◆	◆◆◆
ART ROOMS	◆◆◆	◆	◆◆
SCIENCE ROOMS	◆◆◆	◆	◆
CAFETERIA	◆◆◆	◆	◆
MULTI-PURPOSE ROOMS	◆	◆	◆◆
SPECIAL NEEDS CLASSROOMS	◆	◆	◆◆◆
LIBRARY	◆	◆◆	◆◆◆
COMPUTER ROOMS	◆	◆◆	◆◆◆
ADMINISTRATIVE AREAS	◆	◆◆	◆◆◆
RESTROOMS	◆◆◆	◆	◆

*Flow through carpet

◆=Poor ◆◆=Good ◆◆◆=Excellent

IAQ is also a particular concern because conventional carpets are constructed with synthetic latex, hot melt or urethane backings. These porous backings allow water from cleaning, spills or leaky pipes to soak through the backing to the sub floor where mold and mildew grows.

The Consortium classified these properties as "flow through" backings. They agreed that flow through backing products would not provide the properties necessary to keep moisture and contaminants out of the backing and away from the substrate. As moisture and contaminants become lodged in the backing, they are suspected of contributing to poor IAQ. The group concluded that an impermeable backing is preferred.

Vinyl Cushion Tufted Textiles (VCTT)

This conclusion led the consortium to review a third type of flooring - a hybrid called vinyl cushion tufted textile or VCTT. VCTT is dramatically different from conventional carpet in that VCTT is made with a surface of dense, low-tufted (type 6,6) textile. By contrast, conventional carpet is constructed with a loose, high yarn construction. The low and dense construction, according to the Consortium, would reduce the concentration of contaminants, while still providing the benefits of a soft surface - that is, elimination of glare, acoustic improvement, reduction of slip/fall hazards and ergonomic comfort - so children can sit on the floor in comfort.

Of major importance to the Consortium was that VCTT is made of resilient, long-lasting backing made of a closed-cell vinyl cushioning that is water-impermeable. This unique backing structure allows for permanently welded seams, inhibits mold and mildew, and eliminates the "sinks" (common to conventional carpet) that harbor allergens. VCTT can be cleaned with minimal effort using low impact detergents and is backed by a 20-year non-prorated warranty.

First introduced in the early 1960s, VCTT's long-term performance and contributions to air quality were not of prime importance. However, over the years, as these attributes have become important, and VCTT's technology has continued to evolve, the flooring has increasingly been specified. The Consortium was particularly interested in the construction characteristics of the flooring known as "link engineering." Through "link engineering," the backing, surface nylon yarn (with low and dense nylon construction) and dry virtually VOC-free installation adhesive are interlocked to provide a complete package for IAQ protection. In addition, the members discussed the environmental sustainability of VCTT. Made with a durable closed cell vinyl cushion backing, VCTT when reclaimed, meets Federal Trade Commission (FTC) guides for 100% recyclability.

Preventing Mold And Mildew

Mold and mildew are the result of moisture intrusion from any source. Temperature conditions can also contribute to microbial growth when the ambient air reaches dew point. According to the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE), schools should be maintained at relative humidity between 30% and 60%.[2] However, as members of the Consortium discussed, in the "real world" moisture comes from a number of sources. In new construction, the curing process can introduce moisture into the slab; by rain, snow, spills, leaks and condensation.

If VCT is used, the challenge is to control the moisture that typically penetrates between the tiles. VCT requires constant maintenance with 5-7 layers of wax to provide resistance to water. Although waxing the floor creates a moisture barrier, as the wax wears off, dirt and moisture penetrate the joints or seams between the tiles as evidenced by the little black lines between the tiles – which can be the beginning of an IAQ problem.

Conventional carpet presents an equally complex set of challenges. As the Consortium noted, conventional carpet backing is made with latex or urethane, which is water-absorbent. Any backing where seams cannot be permanently welded (considered "flow through" backing) increases the opportunity for poor IAQ. Moisture can seep below the conventional carpet surface, through its backing to the sub floor beneath. Unfortunately, regular cleaning with hot water extraction-combined with the humidity of school buildings and the long drying time for conventional carpet of 10 or more hours, promotes bacterial growth.

By contrast, VCTT is specifically designed for the rugged school environment. Its closed-cell vinyl cushion backing and permanently welded seam construction suspend water and spills above the backing. This keeps the product and sub floor completely dry. During regular cleaning, VCTT typically dries in less than four hours. VCTT's has a unique ability to withstand flooding. Case studies compiled over the years document that the VCTT backing holds floodwaters above the product backing, and keeps them suspended until the water is removed with professional extraction. Then, with professional hot water extraction cleaning, VCTT can be restored back to its original "pre-flood" condition.

In concluding the discussion on moisture problems in schools, the IAQ Consortium recommended a closed cell vinyl cushion backing as the first line of defense to control and improve IAQ. In addition, to insure impermeability, they recommended that all backings pass the "Moisture Penetration by Impact Test." To pass this inspection, products are considered moisture impermeable after 10,000 impacts. Testing must be conducted on the seam, as well as on the overall product, to insure impermeability.

Controlling Dust and Particles

National research has indicated that one of the most pressing concerns for school planners today is dust and airborne allergens. More children in the U.S. today are being diagnosed with asthma than ever before – the latest figures show a 74% increase from 1980 to 1994, according to the Centers for Disease Control and Prevention.[3]

During the Consortium, discussion focused on research on the presence of dust and particulates that may aggravate asthma – regardless of the age of the school or the type of flooring. Controlling allergens is the key to good indoor air quality; controlling them successfully requires understanding their behavior. Allergens begin as airborne dust and particulates, but quickly fall to the floor. If they can be contained at the floor level until removed, the damage to air quality is minimal. With VCT and other hard-surface flooring, allergens are continually "kicked up" through foot traffic back into the breathing zone.

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[2] ASHRAE STANDARDS 62-1999, www.ashrae.org

[3] Center for Disease Control and Prevention, National Center for Environmental Health, Asthma's Impact on Children and Adolescents, http://www.cdc.gov/nceh/airpollution/asthma/children.htm

By contrast, conventional carpet and vinylcushion tufted textile flooring are able to trap allergens at the floor level. While all soft-surface flooring yarns can hold allergens temporarily, the type of surface yarn can impact the results. Unlike conventional carpet, VCTT yarn construction is extremely low and dense, reducing buildup of contaminants and keeping them near the surface for easy removal. The Consortium members recommended that the face yarn constructions should be specified to have *no more* than 20 ounces per square yard as the total face weight of the yarn system. Anything higher was judged to potentially contribute to poor IAQ.

Eliminating Volatile Organic Compounds

According to a maintenance expert at the Consortium, volatile organic compounds created by floor cleaning products and installation are a major issue for school maintenance crews. VCT floors require frequent stripping and waxing for warranty coverage. Yet, the EPA recommends that when VCT floors are stripped and finished, the building should remain unoccupied for at least 48-hours to allow sufficient time for VOC off-gassing. In an era where school facilities are often used from early morning to late at night, vacating a school until VOCs dissipate can cause major disruptions to educational programs.

By contrast, both conventional carpet and VCTT can be cleaned with hot water extraction – not only eliminating harsh chemicals but also eliminating up to 99 percent of allergens, fungi and bacteria in post-cleaning tests. However, because conventional carpeting has a "flow through" backing, and can require more than 10 hours to dry, leaving it prone to mold and mildew growth.

VOCs may also result when wet glues are used to install VCT and conventional carpets. VCTT, on the other hand, is installed without wet glues by using a "peel and stick" dry adhesive. Installation is fast and there is no off gassing from adhesives. VCTT is frequently installed during normal school hours, while the building is occupied.

To date, only VCTT flooring meets the state of Washington's IAQ protocol, immediately upon installation. By comparison, other floorings require an off gassing period. In addition, VCTT outperforms the current "green label" standards for off-gassing by floor coverings with adhesives as set by the Carpet and Rug Institute. VCTT achieves a measurement that is 20 times better than the CRI allowable standard.

Flooring and Its Costs

Although good IAQ is essential in all school planning and construction, the Consortium also recognized that IAQ plans must include the ability to keep the choices affordable. The Consortium reviewed comparative flooring maintenance costs. Using published maintenance costs for VCT and VCTT, costs for maintenance of a 90,000 square foot school over 20 years were calculated. VCT, assuming normal maintenance conditions costs about $94,500 per year to maintain. VCTT floor, again assuming normal maintenance conditions, calculated at less than $35,000 per year to maintain, or a potential savings of $60,000 per year.

Summing It Up

Good indoor air quality in schools is rapidly becoming a national "educational bill-of-rights" issue, as one teacher described it. As more is known about how the physical school environment affects productivity and learning, IAQ is becoming the most challenging issue with the most recognized rewards. Careful selection of interior materials, particularly the choice of flooring, can make a considerable contribution not only to good indoor air quality but also to the total learning environment.

ISSUETRAK is prepared by The Council of Educational Facility Planners International as a service to its membership.

CEFPI wishes to thank David Frank for his invaluable time and expertise in preparing this brief.

David Frank is the President of KnowledgeWorx. He has over twenty-five years of industry experience. David is a nationally recognized authority in facility management, team cleaning indoor air quality, cleaning system design and many other topics related to the cleaning industry.

The opinions expressed in this article are those of the author and do not necessarily reflect the position of the Council of Educational Facility Planners International, its officers or membership.

THE COUNCIL OF EDUCATIONAL FACILITY PLANNERS INTERNATIONAL
9180 E. Desert Cove Dr., Suite 104 Scottsdale, AZ 85260
Phone: 480.391.0840 Fax: 480.391.0940 email: cefpi@cefpi.org www.cefpi.org

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